IN THE CLAIMS:

All of the pending claims 1 through 14 and 18 through 73 are presented below. This listing of claims will replace all prior versions and listings of claims in the application. Please enter these claims as amended. It is noted that amendments entered in the previous reissue application (i.e., those set forth in Reissued Patent No. RE37,853) are denoted by single brackets for deletions and italics for insertions; new amendments which are considered to be part of the present application are set forth in double brackets for deletions and double underlining for insertions.

Please amend claims 5-7, 11-14, 18, 19, 21, 22, 24, 31-45, 47-66, and 68-72 as set forth below.

1. (Original) A fast quench reactor for thermal conversion of one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, comprising:

a reactor chamber having axially spaced inlet and outlet ends along a reactor axis;

[a] high temperature heating means positioned at the inlet end of the reactor chamber;

a reactant stream inlet for introducing a stream comprising at least one reactant within the reactor chamber where said stream is heated by said high temperature heating means to produce a hot gaseous stream flowing axially toward the outlet end of the reactor chamber;

the reactor chamber having a predetermined length sufficient to effect heating of the reactant stream by the high temperature heating means to a selected equilibrium temperature at which a desired end product is available within the reactant stream as a thermodynamically stable reaction product at a location adjacent the outlet end of the reaction chamber;

a convergent-divergent nozzle located coaxially within the outlet end of the reactor chamber for rapidly cooling the gaseous stream by converting thermal energy to kinetic energy as a result of adiabatic and isentropic expansion as the gaseous stream flows axially through the nozzle, *the convergent-divergent nozzle having a converging section and a diverging*

section respectively leading to and from a restrictive open throat, the diverging section having a conical configuration centered along the reactor axis and having an included angle in the range of 6° to 14°; and

a cool down chamber leading from the nozzle for retaining the desired end product within the flowing gaseous stream [, and wherein the nozzle and cool down chamber are designed to minimize back reactions].

2. (Original) The fast quench reactor of claim 1, wherein the high temperature heating means comprises a plasma torch, *a plasma torch exit disposed between the plasma torch and the reaction chamber,* and a plasma arc inlet for introducing a stream of plasma arc gas to the plasma torch to produce a plasma within the reaction chamber and extending toward the outlet end of the reaction chamber, the plasma containing at least one reactant, whereby the inlet reactant stream is mixed into the plasma to progressively effect heat transfer between the plasma and a resulting gaseous stream.

3. (Original) The fast quench reactor of claim [2] *1,* further comprising:
a reactant inlet connected to a source of gas which dissociates at or below the equilibrium temperature to produce the desired end product.

4. (Original) The fast quench reactor of claim [2] *1,* further comprising:
separate reactant inlets respectively connected to sources of two different gaseous reactants which react with one another at or below the equilibrium temperature to produce the desired end product.

5. (Currently Amended) The fast quench reactor of claim [2] *1,* wherein the [[minimum]] <u>the high temperature heating means is configured to heat the reactant stream</u> [[temperature]] within the reactor chamber [[is]] <u>to a temperature</u> between about 1700° C. and about 4000° C.

6. (Currently Amended) The fast quench reactor of claim [2] *1*, wherein the ~~convergent-divergent nozzle is configured to cool~~ [[maximum temperature of]] the gaseous stream exiting the nozzle [[is less than]] to about 500° C ~~or less~~.

7. (Currently Amended) The fast quench reactor of claim [2] [[*1*]] 2, further comprising:
a reactant inlet operably connected to a source of reactant under positive pressure, whereby the reactant is positively injected into the reactor chamber to penetrate and mix with the plasma.

8. (Original) The fast quench reactor of claim [2] *1*, further comprising:
a product collector positioned downstream from the cool down chamber.

9. (Original) The fast quench reactor of claim [2] *1*, further comprising:
an external cooling system operably connected to the cool down [section] *chamber*.

10. (Original) The fast quench reactor of claim 2, wherein both the *plasma torch* exit [opening] and *the* reactor chamber are coaxially centered along the reactor axis.

11. (Currently Amended) The fast quench reactor of claim 2, wherein both the *plasma torch* exit [opening] and *the* reactor chamber are coaxially centered along the reactor axis, [[the]] a width of the reactor chamber being no larger than approximately 200% of ~~a width of~~ the *plasma torch* exit [opening] [[width]].

12. (Currently Amended) The fast quench reactor of claim 2, wherein both the *plasma* torch exit and *the* reactor chamber are circular in cross section and are coaxially centered along the reactor axis, [[the]] a diameter of the reactor chamber being in the range of approximately 110% to 150% of ~~a width of~~ the *plasma torch* exit [opening diameter] [[*width*]].

13. (Currently Amended) The fast quench reactor of claim [2] *1*, wherein [the nozzle has a converging section and a diverging section respectively leading to and from a restrictive open throat;] the converging section of the nozzle [having] [[*has*]] ~~is configured to provide~~ a high aspect ratio ~~transition with respect to a cross-sectional area of an opening of the outlet end of the reaction chamber and a cross-sectional area of the nozzle throat~~.

14. (Currently Amended) The fast quench reactor of claim [2] *1*, wherein [the nozzle has a converging section and a diverging section respectively leading to and from a restrictive open throat;] the converging section of the nozzle [having] [[*has*]] ~~provides~~ a high aspect ratio ~~transition with respect to a cross-sectional area of an opening of the outlet end of the reaction chamber and a cross-sectional area of the nozzle throat including~~ [[presented by]] successive [[convex and]] concave ~~and convex~~ surfaces leading into [a] *the* nozzle throat having a circular cross section, [[the]] ~~a~~ radius of the convex ~~surface~~ and ~~a radius of the~~ concave [[surfaces]] ~~surface each~~ being approximately equal to [[the]] ~~a~~ diameter of the nozzle throat.

15 – 17 (Cancelled in first reissue)

18. (Currently Amended) The fast quench reactor of claim [2, wherein the nozzle has a converging section and a diverging section respectively leading to and from a restrictive open throat; the fast quench reactor] *1*, further comprising:
an additional inlet leading to the throat of the nozzle for directing [[an]] ~~a~~ quenching gas into the hot gaseous stream at a rate that condenses a desired reaction product and inhibits formation of other equilibrium products as the resulting hot gaseous stream exits the nozzle.

19. (Currently Amended) The fast quench plasma reactor for thermal conversion of one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, comprising:
an enclosed reactor chamber arranged along a reactor axis, the reactor chamber having axially

spaced inlet and outlet ends;

a plasma torch including at least one pair of electrodes positioned at the inlet end of the reactor chamber;

a plasma arc gas inlet upstream from the electrodes for introducing a stream of plasma arc gas between the electrodes at a selected plasma gas flow while the electrodes are subjected to a selected plasma input power level to produce a plasma within the reactor chamber and extending toward the outlet end of the reactor chamber, the plasma containing at least one reactant[, whereby an incoming reactant stream is mixed into the plasma to progressively effect heat transfer between the plasma and a resulting gaseous stream as the gaseous stream flows axially toward the outlet end of the reactor chamber];

at least one reactant inlet leading into the reactor chamber at or adjacent to its inlet end at a selected injection angle, *whereby an incoming reactant stream is mixed into the plasma to progressively effect heat transfer between the plasma and a resulting gaseous stream as the gaseous stream flows axially toward the outlet end of the reactor chamber*;

the reactor chamber having a predetermined length sufficient to effect heating of the gaseous stream by the plasma to a selected equilibrium temperature at which a desired end product is available as a thermodynamically [unstable] *stable* reaction product at a location adjacent the outlet end of the reactor chamber;

a coaxial convergent-divergent nozzle positioned in the outlet end of the reactor chamber for rapidly cooling the gaseous stream by converting thermal energy to kinetic energy as a result of adiabatic and isentropic expansion as it flows axially through the nozzle, the nozzle having a converging section and a diverging section respectively leading to and from a restrictive open throat;

the converging section of the nozzle [[having]] ~~configured to provide~~ a high aspect ratio ~~transition with respect to a cross-sectional area of an opening at the outlet end of the reactor chamber and a cross-sectional area of the nozzle throat to accelerate~~ [[for accelerating]] the gaseous stream rapidly into the nozzle throat while maintaining laminar flow;

the size of the restrictive open throat within the nozzle being selected to control the residence time and reaction pressure of the resulting gaseous stream in the reactor chamber;

the gaseous stream being accelerated to sonic velocities during passage through the throat of the nozzle to transform thermal energy of the moving gaseous stream into kinetic energy in the axial direction of gas flow, thereby retaining the desired end product within the flowing gaseous stream;

the diverging section of the nozzle then subjecting the gaseous stream to an ultra fast decrease in pressure by smoothly accelerating and expanding the moving gaseous stream;

a coaxial cool down chamber leading from the diverging section of the nozzle for reducing the velocity of the moving gaseous stream while removing heat energy at a rate sufficient to prevent increases in its kinetic temperature to retain the desired end product within the gaseous stream; and wherein the diverging section of the nozzle and cool down chamber are designed to minimize undesired side or back reactions; and

a product collector downstream of the cool down chamber to separate a desired reaction product from the gases exiting the cool down chamber.

20. (Original) The fast quench plasma reactor of claim 19, further comprising: an external cooling system operably connected to the cool down [section] *chamber* to remove heat energy from the moving gaseous stream at a rate sufficient to prevent the gas from increasing in kinetic temperature as it traverses the cool down chamber.

21. (Currently Amended) The fast quench plasma reactor of claim 19, wherein [both] the ~~<u>plasma</u>~~ torch includes a plasma inlet coaxially centered along the reactor chamber axis and both the plasma [inlet] *torch exit disposed between the plasma torch and the reactor chamber and coaxially centered along the reactor* [[*chamber*]] *axis, and both the plasma torch exit* and the interior of the reactor chamber are circular in cross section.

22. (Currently Amended) The fast quench plasma reactor of claim [19] *21*, wherein [both

the torch includes a plasma inlet coaxially centered along the reactor chamber axis and both the plasma inlet and the interior of the reactor chamber are circular in cross section,] [[the]] a diameter of the reactor chamber [being] *is* no larger than approximately 200% of [[the]] [torch exit] a diameter [to prevent recirculation of reaction gases in the reaction chamber] *of the plasma torch exit.*

23. (Original) The fast quench plasma reactor of claim [19] *21*, wherein [both the torch includes a plasma inlet coaxially centered along the reactor chamber axis and both the plasma inlet and the interior of the reactor chamber are circular in cross section,] the diameter of the reactor chamber being *is* in the range of approximately 110% to 150% of the [torch exit] diameter [to prevent recirculation of reaction gases in the reaction chamber] *of the plasma torch exit.*

24. (Currently Amended) The fast quench plasma reactor of claim 19, wherein the converging section of the nozzle has [a high aspect ratio presented by] successive [[convex and]] concave and convex surfaces leading into [a] *the* nozzle throat, *the nozzle throat* [having] *has* a circular cross section, *and* [[the]] wherein a radius of the convex surface and a radius of the concave surface [[surfaces]] [being] [[*is*]] are each approximately equal to [[the]] a diameter of the nozzle throat.

25. (Original) The fast quench plasma reactor of claim 19, wherein the diverging section of the nozzle has a conical configuration centered along the reactor axis with an included angle of less than 35° for optimum expansion and acceleration of the hot gaseous stream passing through it to minimize undesired size and back reactions.

26. (Original) The fast quench plasma reactor of claim 19, wherein the diverging section of the nozzle has a conical configuration centered along the reactor axis with an included angle in the range of 6° to 14° for optimum expansion and acceleration of the hot gaseous stream passing

through it.

27. (Original) The fast quench plasma reactor of claim 19, further comprising:
an additional inlet leading to the throat of the nozzle for directing a quenching gas into the hot gaseous stream at a rate that condenses desired reaction products and inhibits formation of other equilibrium products as the resulting hot gaseous stream exits the nozzle.

28. (Original) The fast quench plasma reactor of claim 19, further comprising:
vacuum means operatively connected downstream of the convergent-divergent nozzle for applying vacuum pressure to the gaseous stream exiting from the nozzle.

29. (Original) [An apparatus as set out in] *The fast quench plasma reactor of* claim 19, further comprising:
first cooling means for *cooling* the walls of the reactor chamber to prevent reactions with its materials of construction.

30. (Original) [An apparatus as set out in] *The fast quench plasma reactor of* claim 19, further comprising:
first cooling means for *cooling* the walls of the reactor chamber to prevent reactions with its materials of construction; and
second cooling means for *cooling* the convergent-divergent nozzle to prevent reactions with its materials of construction.

31. (Currently Amended) A method for thermally converting one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, comprising [[the following steps]]:
introducing a reactant stream at one axial end of a [reaction] *reactor* chamber *having an inlet end and an outlet end, the reactant stream before reaction or thermal decomposition thereof comprising at least one reactant selected from the group consisting of titanium*

tetrachloride, vanadium tetrachloride, aluminum trichloride and natural gas;

rapidly heating the incoming reactant stream as the reactant stream flows axially toward the [remaining] *outlet* end of the reactor chamber;

the reactor chamber having a predetermined length sufficient to effect heating of the gaseous stream to a selected reaction temperature at which [a] *the* desired end product is available as a thermodynamically [unstable] *stable* reaction product at a location adjacent the outlet end of the reactor chamber;

passing the gaseous stream through a restrictive convergent-divergent nozzle arranged coaxially within the [remaining] *outlet* end of the reactor chamber to rapidly cool the gaseous stream by converting thermal energy to kinetic energy as a result of adiabatic and isentropic expansion as it flows axially through the nozzle and minimizing back reactions, thereby retaining the desired end product within the flowing gaseous stream; and

subsequently cooling and slowing the velocity of the desired end product and remaining gaseous stream exiting from the nozzle.

32. (Currently Amended) The method of claim 31, wherein the [[rapid heating step is accomplished by]] ~~rapidly heating the incoming reactant stream further includes~~ introducing a stream of plasma arc gas to a plasma torch at the [one axial] *inlet* end of said reactor chamber to produce a plasma within the [reaction] *reactor* chamber which extends toward its [remaining axial] *outlet* end.

33. (Currently Amended) The method of claim 31, [wherein the step of rapidly cooling the desired end product is accomplished by use of a converging section of the nozzle having a high aspect ratio and] further comprising [[the following additional step:]] separating the desired end product from the remaining gases in the cooled gaseous stream.

34. (Currently Amended) The method of claim 31, ~~further comprising configuring the~~

[[wherein the]] [step of rapidly cooling the desired end product is accomplished by use of] [[*converging-diverging*]] convergent-divergent *nozzle* [[*has*]] to include a converging section [of the nozzle] [[having]] which provides a high aspect ratio transition with respect to a cross-sectional area of an opening of the outlet end of the reaction chamber and a cross-sectional area of a nozzle throat including [[*and* presented by]] successive [[convex and]] concave and convex surfaces leading into [[a]] the nozzle throat [[having a circular cross section]], [[the]] a radius of the convex surface and a radius of the concave [[surfaces]] surface being approximately equal to [[the]] a diameter of the nozzle throat.

35. (Currently Amended) The method of claim 31, further comprising configuring the [[wherein the]] [step of rapidly cooling the desired end product is accomplished by use of a] [[*converging-diverging*]] convergent-divergent nozzle [having] [[*has*]] to include a converging section and a diverging section respectively leading to and from a restrictive open throat, and configuring the diverging section of the nozzle [[having]] to exhibit a substantially conical configuration.

36. (Currently Amended) The method of claim 35 [[31]], further comprising [[wherein the]] [step of rapidly cooling the desired end product is accomplished by use of a] [[*converging-diverging* nozzle [having] *has* a converging section and a diverging section respectively leading to and from a restrictive open throat,]] configuring the diverging section of the nozzle [[having]] to exhibit a substantially conical configuration with an included of less than about 35°.

37. (Currently Amended) The method of claim 31, wherein the step of subsequently cooling and slowing the velocity of the resulting desired end product and remaining gaseous stream [[as it exits]] exiting from the nozzle [[is accomplished by]] further includes directing a quenching gas into the gaseous stream at a rate than condenses [a] *the* desired end product and inhibits formation of other equilibrium products as the resulting gaseous stream exits the nozzle.

38. (Currently Amended) The method of claim 31, wherein retaining the desired end product ~~within the flowing gaseous stream includes retaining~~ [[is]] titanium metal and ~~wherein introducing the reactant stream includes introducing~~ [[the]] [reactants are] [[*at least one reactant comprises*]] titanium tetrachloride and hydrogen.

39. (Currently Amended) The method of claim 31, wherein retaining the desired end product ~~within the flowing gaseous stream includes retaining~~ [[is]] vanadium metal and ~~wherein introducing the reactant stream includes introducing~~ [[the]] [reactants are] [[*at least one reactant comprises*]] vanadium tetrachloride and hydrogen.

40. (Currently Amended) The method of claim 31, wherein retaining the desired end product ~~within the flowing gaseous stream includes retaining~~ [[is]] aluminum metal and ~~wherein introducing the reactant stream includes introducing~~ [[the]] [reactants] [[*at least one reactant comprises* are]] aluminum chloride and hydrogen.

41. (Currently Amended) The method of claim 31, wherein retaining the desired end product ~~within the flowing gaseous stream includes retaining~~ [[is]] a titanium-vanadium alloy and ~~wherein introducing the reactant stream includes introducing~~ [[the]] [reactants are] [[*at least one reactant comprises*]] a mixture of titanium tetrachloride, [and] vanadium tetrachloride, [plus] *and* hydrogen, *or a mixture of titanium tetrachloride, vanadium trichloride and hydrogen.*

42. (Currently Amended) The method of claim 31, wherein retaining the desired end product ~~within the flowing gaseous stream includes retaining~~ [[is]] a titanium-boron composite ceramic powder and ~~wherein introducing the reactant stream includes introducing~~ [[the]] [reactants are] [[*at least one reactant comprises*]] titanium tetrachloride and boron trichloride.

43. (Currently Amended) The method of claim 31, wherein retaining the desired end product ~~within the flowing gaseous stream includes retaining~~ [[is]] titanium dioxide and ~~wherein~~

~~introducing the reactant stream includes introducing~~ [[the]] [reactants are] [[*at least one reactant comprises*]] titanium tetrachloride and oxygen.

44. (Currently Amended) The method of claim 31, wherein ~~retaining~~ the desired end product ~~within the flowing gaseous stream includes retaining~~ [[is]] acetylene and ~~wherein introducing the reactant stream includes introducing~~ [[the]] [reactants are] [[*at least one reactant comprises*]] methane and hydrogen.

45. (Currently Amended) A method for thermal conversion of one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, comprising [[the following steps]]:

introducing a stream of plasma arc gas between the electrodes of a plasma torch including at least one pair of electrodes positioned at the inlet end of an axial reactor [chamber,] *chamber having an inlet end and an outlet end,* the stream of plasma arc gas being introduced at a selected plasma gas flow while the electrodes are subjected to a selected plasma input power level to produce a plasma within the reactor chamber and extending toward its outlet end;

thoroughly mixing an incoming reactant stream into the plasma by injecting at least one reactant into the reactor chamber at or adjacent to its inlet end at a selected injection angle and at a selected reactant input rate to progressively effect heat transfer between the plasma and the resulting gaseous stream as it flows axially toward the outlet end of the reactor chamber, *the at least one reactant selected from the group consisting of titanium tetrachloride, vanadium tetrachloride, aluminum trichloride and natural gas*;

the length of the reactor chamber being sufficient to effect heating of the gaseous stream to a selected equilibrium temperature at which a desired end product is available as a thermodynamically [unstable] *stable* reaction product within the gaseous stream at a location adjacent to the outlet end of the reactor chamber;

directing the gaseous stream through a coaxial convergent-divergent nozzle positioned in the

outlet end of the reactor chamber to rapidly cool the gaseous stream by converting thermal energy to kinetic energy as a result of adiabatic and isentropic expansion as it flows axially through the nozzle, the nozzle having a converging section and a diverging section respectively leading to and from a restrictive open throat;

cooling the gaseous stream exiting the nozzle by reducing its velocity while removing heat energy at a rate sufficient to prevent increases in its kinetic temperature; and

separating *the* desired end [products] *product* from the gases remaining in the cooled gaseous stream.

46. (Currently Amended) The method of claim 45, ~~further comprising configuring~~ [further comprising the following step:

accelerating] [[*wherein*]] *the converging section of the nozzle* [[*has*]] ~~to provide~~ *a high aspect ratio* ~~transition with respect to a cross-sectional area of an opening of the outlet end of the reaction chamber and a cross-sectional area of a nozzle throat~~ [[*and is configured so that*]] ~~and to accelerate~~ the gaseous stream [[*accelerates*]] rapidly into the nozzle throat while maintaining laminar flow [by passage of the gaseous stream through a converging section of the nozzle having a high aspect ratio].

47. (Currently Amended) The method of claim 45, further comprising [[the following step:]]

controlling the residence time and reaction pressure of the gaseous stream in the reactor chamber by [selection of] *selecting* the size of the restrictive open throat within the nozzle.

48. (Currently Amended) The method of claim 45, ~~further comprising~~ [further comprising the following step: accelerating] [[*wherein the converging-diverging*]] ~~configuring the convergent-divergent~~ *nozzle*[[*is adapted*]] *to accelerate* the gaseous stream to sonic velocities during passage through the throat of the nozzle to transform thermal energy of the moving gaseous stream into kinetic energy in the axial direction of gas flow, thereby retaining

the desired end product within it.

49. (Currently Amended) The method of claim 45, further comprising [[the following step:]]
subjecting the gaseous stream to an ultra fast decrease in pressure by smoothly accelerating and expanding the moving gaseous stream along the diverging section of the nozzle to further decrease its kinetic temperature and prevent undesired side or back reactions.

50. (Currently Amended) A method for producing [titanium,] *titanium or titanium oxide,* comprising the following steps:

decomposing a titanium compound by introducing it as a stream of vapor into a hot plasma together with one or more reactants;

directing the resultant hot gaseous stream through a convergent-divergent nozzle to allow its contents to reach thermodynamic equilibrium prior to being subjected to an ultrafast decrease in pressure; and

quenching [the] titanium *or titanium oxide* within the hot gaseous stream by introducing cold gas into [it] *the hot gaseous stream* as it passes through the nozzle to cool its contents [[as]] <u>at</u> a rate that condenses titanium *and titanium oxide* and inhibits formation of equilibrium products as the resulting gaseous stream exits the convergent-divergent nozzle.

51. (Currently Amended) The method of claim 50, further comprising [[the step of]] introducing sufficient carbon to the hot plasma to prevent formation of titanium oxides.

52. (Currently Amended) The method of claim 50, further comprising [[the step of]] introducing methane to the hot plasma in quantities sufficient to supply adequate carbon to prevent formation of titanium oxides.

53. (Currently Amended) The method of claim 50, ~~further comprising providing oxygen~~

~~as a reactant of~~ [further comprising the step of introducing sufficient] [[*wherein*]] *the one or more reactants* [[*comprises* oxygen]] [to the hot plasma] *in an amount sufficient* to produce titanium dioxide as the desired end product.

54. (Currently Amended) The method of claim 50, ~~further comprising heating the hot plasma to a~~ [[wherein the]] temperature [[of the hot plasma is]] in excess of ~~approximately~~ 4000 K.

55. (Currently Amended) The method of claim 50, ~~further comprising providing hydrogen as at least one reactant of~~ [[wherein]] the *one or more* reactants [include] [[*comprises* hydrogen]].

56. (Currently Amended) The method of claim 50, ~~further comprising introducing~~ [[wherein]] the stream of titanium *compound* vapor [[is contained within argon as]] in an inert carrier gas *comprising argon.*

57. (Currently Amended) The method of claim 50, ~~further comprising maintaining~~ [[wherein]] the hot plasma [[is maintained]] at ~~a substantially~~ atmospheric pressure and ~~exposing~~ the resulting gaseous stream exiting the convergent-divergent nozzle to [[is at]] a vacuum pressure.

58. (Currently Amended) *A method of forming a metal, metal oxide, metal alloy, or ceramic from a metal-containing compound, the method comprising* [[*the steps of*]]*:*

(a) providing a plasma formed from a gas comprising an inert gas, hydrogen, or a mixture thereof;

(b) providing a reagent or a reagent mixture, the reagent or reagent mixture comprising a gaseous or volatilized compound of a selected metal;

(c) contacting the reagent or reagent mixture with the plasma for a time and at a reaction temperature sufficient to form an equilibrium mixture comprising the selected metal, metal oxide, metal alloy, or ceramic thereof, the selected metal, metal oxide, metal alloy, or ceramic being thermodynamically stable at the reaction temperature; and

(d) adiabatically and isentropically expanding the equilibrium mixture to rapidly cool the mixture, thereby retaining the selected metal, metal oxide, metal alloy, or ceramic in a cooled product mixture.

59. (Currently Amended) *The method of claim 58, wherein* providing a reagent or a reagent mixture further includes providing [[*the gaseous or volatilized compound of the selected metal is*]] *a gaseous or volatilizable halide.*

60. (Currently Amended) *The method of claim 58, wherein* providing a reagent or a reagent mixture further includes providing [[*the selected metal is*]] *titanium, vanadium or aluminum.*

61. (Currently Amended) *The method of claim 58, wherein* providing a reagent or a reagent mixture further includes providing [[*the compound of the selected metal is*]] *titanium tetrachloride, vanadium tetrachloride or aluminum trichloride.*

62. (Currently Amended) *The method of claim 58,*[[*wherein the reagent or reagent mixture further comprises*]] further comprising providing *at least one additional reagent capable of reacting at the reaction temperature to form an equilibrium mixture comprising an oxide or alloy of the selected metal.*

63. (Currently Amended) *The method of claim 58, wherein the method forms titanium metal, and* wherein providing a [[*the*]] *reagent or reagent mixture* further *comprises* providing *titanium tetrachloride.*

64. (Currently Amended) *The method of claim 58, wherein the method forms vanadium metal, and* ~~wherein providing a~~ [[*the*]] *reagent or reagent mixture* ~~further~~ *comprises* ~~providing~~ *vanadium tetrachloride.*

65. (Currently Amended) *The method of claim 58, wherein the method forms aluminum metal, and* ~~wherein providing a~~ [[*the*]] *reagent or reagent mixture* ~~further~~ *comprises* ~~providing~~ *aluminum trichloride.*

66. (Currently Amended) *The method of claim 58, wherein the method forms an alloy of titanium and a second metal, and* ~~wherein providing a~~ [[*the*]] *reagent or reagent mixture* ~~further~~ *comprises* ~~providing~~ *titanium chloride and a gaseous or volatilizable compound of the second metal.*

67. (Original) *The method of claim 66, wherein the second metal is vanadium.*

68. (Currently Amended) *The method of claim 58, wherein the method forms a metal oxide of the selected metal, and* ~~wherein providing a~~ [[*the*]] *reagent or reagent mixture further comprises* ~~providing~~ *oxygen.*

69. (Currently Amended) *The method of claim 58, wherein the method forms titanium oxide, and* ~~wherein providing a~~ [[*the*]] *reagent or reagent mixture* ~~further~~ *comprises* ~~providing~~ *titanium tetrachloride and oxygen.*

70. (Currently Amended) *A method of forming a desired product from a hydrocarbon, the method comprising* [[*the steps of*]]*:*

(a) providing a plasma formed from a gas comprising an inert gas, hydrogen, or a mixture thereof;

(b) providing a reagent or a reagent mixture, the reagent or reagent mixture comprising a gaseous or volatilized hydrocarbon;

(c) contacting the reagent or reagent mixture with the plasma for a time and at a reaction temperature sufficient to form an equilibrium mixture comprising the desired product, the desired product being thermodynamically stable at the reaction temperature; and

(d) adiabatically and isentropically expanding the equilibrium mixture to rapidly cool the mixture, thereby retaining the desired product in a cooled product mixture.

71. (Currently Amended) *The method of claim 70, wherein* ~~providing a reagent or a reagent~~ [[*the reactant or reactant*]] *mixture* ~~further~~ *comprises* ~~providing~~ *natural gas.*

72. (Currently Amended) *The method of claim 70, wherein* ~~providing a reagent or a reagent~~ [[*the reactant or reactant*]] *mixture* ~~further~~ *comprises* ~~providing~~ *methane.*

73. (Original) *The method of claim 70, wherein the desired product comprises acetylene.*